

PROGRESS REPORT

File 8-BX

Contains  
New Cost Estimate

DEVELOPMENT OF  
IMPROVED BLOWOUT PREVENTION PROCEDURES  
TO BE USED IN DEEP WATER DRILLING OPERATIONS

submitted to  
The United States Geological Survey  
Department of the Interior  
Reston, Virginia



PETROLEUM ENGINEERING DEPARTMENT  
Louisiana State University  
Baton Rouge, Louisiana 70803

MAY 1980

PROGRESS REPORT

January 23, 1980 - May 15, 1980

Development of Improved Blowout Prevention  
Procedures for Deep Water Drilling Operations

Contract No. 14-08-0001-17225, Mod. 1  
Effective Date: August 23, 1978  
Expiration Date: August 31, 1982  
Funded Amount - \$187,096.00

Sponsored by  
The United States Geological Survey  
The Department of Interior  
Reston, Virginia

Principal Investigators:

William R. Holden, Professor  
Petroleum Engineering Department

A. T. Bourgoyne, Professor and Chairman  
Petroleum Engineering Department

Bill R. Hise, Professor  
Petroleum Engineering Department

May 16, 1980

## RESEARCH OBJECTIVES

The primary objectives of the proposed research are the development of improved blowout prevention procedures to be used in deep water, floating drilling operations. The overall research plan was divided into eight tasks which would take approximately four years for completion.

The project funding received under the present contract was \$187,096 to perform Tasks 1, 3, 4a-b, and 5. These tasks include:

<u>Task</u>	<u>Description</u>
1	Design of a well for accurately modeling blowout control operations on a floating drilling vessel in deep water.
a.	Well scaling and design.
b.	Preparation of bids and specifications.
3	Documentation of blowout control equipment configuration and procedures used on all floating drilling vessels capable of drilling in deep water.
a.	Equipment configuration.
b.	Shut-in procedures.
c.	Start-up procedures.
d.	Pump-out procedures.
4	Experimental study of shut-in procedures for blowout control on floating drilling vessels in deep water.
a.	Experimental determination of frictional area coefficient profile of modern adjustable chokes and HCR valves used in Blowout Control operations.
b.	Experimental determination of frictional area coefficient profile of modern annular Blowout Preventers During Closure.
5	Experimental Study of Procedures for Handling Upward Gas Migration during the Shut-in Period.
a.	Evaluation of conventional approach requiring use of surface drill pipe pressure.

- b. Evaluation of volumetric methods.
- c. Laboratory investigation of gas bubble fragmentation while rising in a static annulus.
- d. Development of mathematical model of well behavior during shut-in period following a gas kick.
- e. Determination of optimal method of handling upward gas migration during shut-in period.

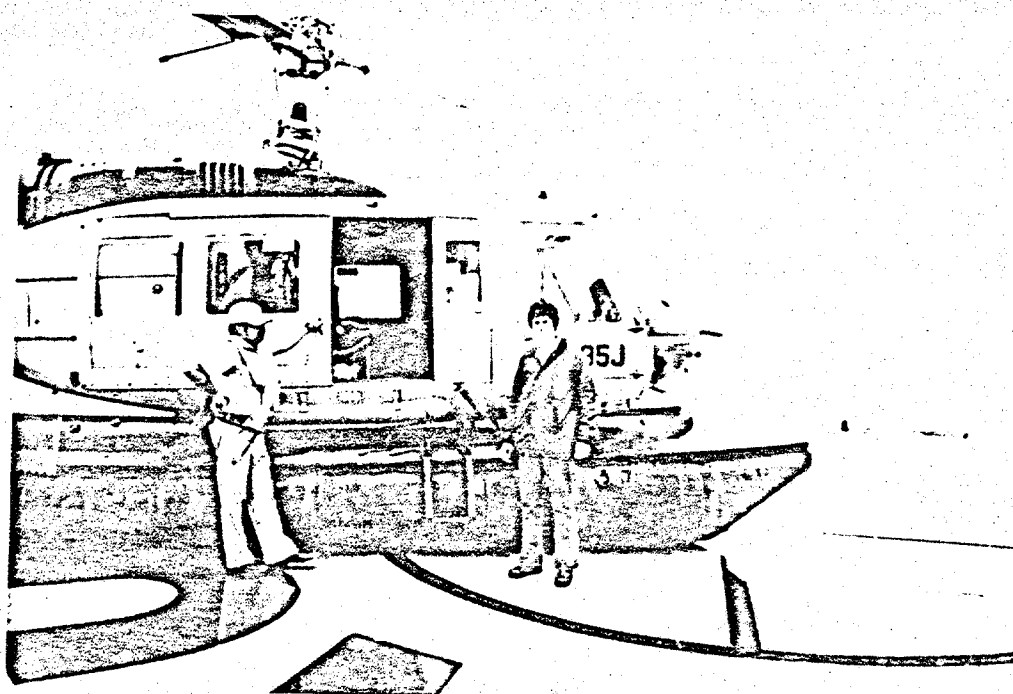
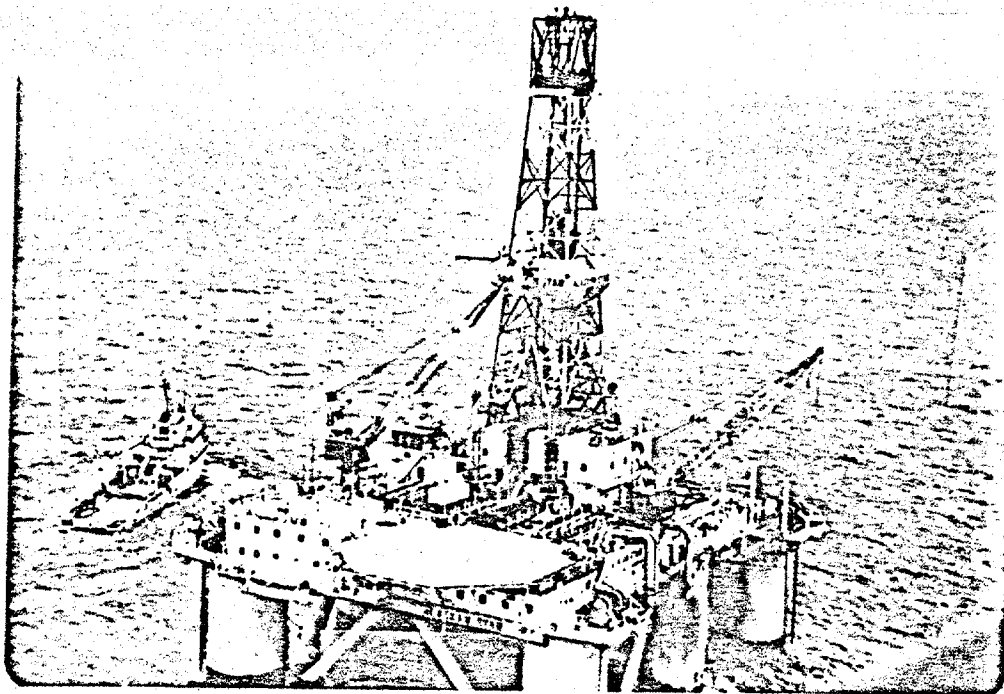
#### ACCOMPLISHMENTS

Task 1, well scaling and design, has been completed. A scale model of the proposed new facility has been constructed. The scale model will facilitate obtaining industry support for much of the needed equipment as well as provide a model for the construction phase of the project.

Work on Task 3, the documentation of blowout control equipment configurations and procedures, is well underway. Several of the vessels currently capable of drilling in water depths of 2000 ft. or more have been visited. Attached photographs were made Easter Sunday during a visit to the Alaskan Star by Bob Surcouf and A. T. Bourgoyne. Much of the needed industry literature and drawings has been collected.

The experimental work on Task 4, an experimental study of shut-in procedures, is almost complete. Kerry Redmann, who has been assigned this task as part of his MS thesis research has begun the data analysis and mathematical modeling phase of the work. Problems with failures in high pressure seals in the flow loop has slowed the collection of data. Completion of Task 4 is now estimated to be August 30, 1980.

The experimental work on Task 5a and 5b, an experimental study of procedures for handling upward gas migration during the shut-in period, is complete. Jeff Mathews has completed his MS thesis and a copy of this thesis will be forwarded to the USGS with our annual report. A technical paper will be prepared for submission to the Society of Petroleum Engineers



on the results of this project. Additional work on tasks 5c, 5d, and 5e is being continued by Vicente Casariego and Scott Doyle.

Before additional experimental tasks can be undertaken, task 2a and 2b must be completed. A proposal for funding of task 2a was submitted during February, 1980. Professor B. R. Hise would have primary responsibility for this task. A presentation on our work to date was made by Dr. A. T. Bourgoyne at the USGS Research and Development Seminar held in Reston, Virginia on April 8-9, 1980.

#### PROBLEMS

No major technical problems have been encountered since our last progress report. A review of our budget shows that the tasks funded to date can be completed without need for additional USGS funding, although a small amount of additional departmental funds from other sources may have to be committed to this research.

At the request of the Procurement and Contracts branch, a revised budget estimate was made for Tasks 2b, 4c, d, 6a,b, 7a,b, 4e, 6c, 7c, and 8 to include the effect of inflation since our last budget estimate in July, 1979 and the projected effect of inflation to the end of the project in 1982. The effect of inflation was not taken into account in the July, 1979 estimate which was audited later in 1979. The revised budget estimates for the remaining subtasks are shown in Tables 1-8. The revised total cost estimate is summarized in Table 9.

Adam T. Bourgoyne, Jr.

Adam T. Bourgoyne, Jr., Chairman

TABLE 1  
SUBTASK 2b

ESTIMATED COST OF NEW WELL FACILITY TO USGS

ITEM		
1.	Move Rig on Location	\$ 2,360
2.	Rig Time for Well Completion 6 Days at 1400 \$/day	9,912
3.	Wireline Work to Set Plug	2,950
4.	Cementing Services	1,180
5.	Disposal of Old Mud and Displacement of Completion Fluid	1,652
6.	Supervision	3,186
7.	Tubulars	
	a. 6000 ft. of 1.315 in. tubing	14,200
	b. 3000 ft. of 2.375 in. tubing	18,656
	c. 6000 ft. of 2.875 in. tubing	44,307
8.	Dual Christmas Tree	23,600
9.	Dual Packer	8,850
10b	Instrumentation	17,000
TOTAL		<u>\$164,853</u>

TABLE 2  
SUBTASK 4c AND 4d COST SUMMARY

1.	Direct Costs	
a.	Personnel	
(1)	Principal Investigator	\$ 17,040
	A. T. Bourgoyne	
	4.125 man-month	
	(12.5% time for 9 months	
	plus full-time for 3 months)	
(2)	Graduate Assistant	7,768
	9.75 man-months	
	(50% time for 13.5 months	
	plus full-time for 3 months)	
(3)	Research Associate	4,458
	3.0 man-months	
	(25% time for 12 months)	
(4)	Typist/Clerk	1,644
	2.4 man-months	
	(20% time for 12 months)	
		<hr/>
	Sub	\$ 30,910
b.	Employee Benefits	5,100
	(16.5 % of 1a.0)	
c.	Computer Services	4,840
d.	Equipment, Drilling Fluid Supplies, and Nitrogen Gas	12,100
e.	Office Supplies and Report Reproduction Costs	1,210
f.	Travel	1,210
2.	Indirect Costs	15,300
	(49.5% of 1a.)	
		<hr/>
	TOTAL	<u>\$ 70,670</u>



TABLE 3  
SUBTASK 6a AND 6b COST SUMMARY

1.	Direct Costs	
	a. Personnel	
	(1) Principal Investigator	
	W. R. Holden	\$ 15,331
	4.125 man-months	
	(12.5% time for 9 months	
	plus full-time for 3 months)	
	(2) Graduate Assistant	5,975
	7.5 man-months	
	(50% time for 9 months	
	plus full-time for 3 months)	
	(3) Research Associate	4,458
	3 man-months	
	(25% time for 12 months)	
	(4) Typist/Clerk	1,644
	2.4 man-months	
	(20% time for 12 months)	
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		Sub \$ 27,408
	b. Employee Benefits	4,522
	(16.5% of 1a.)	
	c. Computer Services	1,815
	d. Equipment, Drilling Fluid Supplies,	12,100
	and Nitrogen Gas	
	e. Office Supplies and Report Reproduction Costs	1,210
	f. Travel	1,210
2.	Indirect Costs	13,567
	(49.5% of 1a.)	
		<hr/>
		TOTAL \$ 61,832

TABLE 4

SUBTASK 7a AND 7b COST SUMMARY

1.	Direct Costs		
	a. Personnel		
	(1) Principal Investigator		
	B. R. Hise	\$	16,628
	4.125 man-months		
	(12.5% of time for 9 months		
	plus full-time for 3 months)		
	(2) Graduate Assistant		5,975
	7.5 man-months		
	(50% time for 9 months		
	plus full-time for 3 months)		
	(3) Research Associate		4,458
	3 man-months		
	(25% time for 12 months)		
	(4) Typist Clerk		1,644
	2.4 man-months		
		Sub	\$ 28,705
	b. Employee Benefits		4,736
	(16.5% of 1a.)		
	c. Computer Services		1,210
	d. Equipment, Drilling Fluid Supplies, and		13,310
	Nitrogen Gas		
	e. Office Supplies and Report Reproduction Costs		1,210
	f. Travel		1,210
2.	Indirect Costs		14,209
	(49.5% of 1a.)		
		TOTAL	<u>\$ 64,590</u>

TABLE 5

SUBTASK 4e COST SUMMARY

1.	Direct Costs		
	a. Personnel		
	(1) Principal Investigator		
	A. T. Bourgoyne, Jr.	\$	5,141
	1.125% man-months		
	(12.5% time for 9 months)		
	(2) Graduate Assistant		3,966
	4.5 man-months		
	(50% time for 9 months)		
	(3) Typist/Clerk		683
	0.9 man-months		
	(10% time for 9 months)		
		Sub	\$ 9,790
	B. Employee Benefits		1,615
	(16.5% of 1a.)		
	c. Computer Services		5,280
	d. Office Supplies and Report Reproduction		1,320
	Costs		
	e. Travel		1,320
2.	Indirect Costs		4,846
	(49.5% of 1a.)		
		TOTAL	<u>\$ 24,171</u>

TABLE 6  
SUBTASK 6c COST SUMMARY

1.	Direct Costs		
	a. Personnel		
	(1) Principal Investigator		
	W. R. Holden	\$	16,959
	4.125 man-months		
	(12.5% time for 9 months		
	plus full-time for 3 months)		
	(2) Graduate Assistant		3,966
	4.5 man-months		
	(50% of time for 9 months)		
	(3) Research Associate		4,931
	3.0 man-months		
	(25% of time for 12 months)		
	(4) Typist/Clerk		683
	0.9 man-months		
	(10% of time for 9 months)		
		Sub	\$ 26,539
	b. Employee Benefits		4,379
	(16.5% of 1a)		
	c. Equipment, Drilling Fluid Supplies, and		11,880
	Nitrogen Gas		
	d. Office Supplies and Report Reproduction Costs		1,320
	e. Travel		1,320
2.	Indirect Costs		13,137
	(49.5% of 1a)		
		TOTAL	<u>\$ 58,575</u>

TABLE 7

SUBTASK 7c COST SUMMARY

## 1. Direct Costs

## a. Personnel

(1)	B. R. Hise 1.125 man-months (12.5% time for 9 months)	\$ 5,018
(2)	Graduate Assistant 7.5 man-months (50% time for 9 months)	6,610
(3)	Research Associate 3 man-months (25% time of 12 months)	4,931
(4)	Typist/Clerk 1.2 man-months (10% time for 12 months)	910

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Sub \$ 17,469b. Employee Benefits 2,882  
(16.5% of 1a)c. Equipment, Drilling Fluid Supplies, and 11,880  
Nitrogen Gas

d. Office Supplies and Report Reproduction Costs 1,320

e. Travel 1,320

2. Indirect Costs 8,647  
(49.5% of 1a.)

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TOTAL \$ 43,518

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TABLE 8  
TASK 8 COST SUMMARY

1.	Direct Costs		
	a. Personnel		
	(1) Principal Investigator		
	A. T. Bourgoyne, Jr.		\$ 18,850
	4.125 man-months		
	(12.5% time for 9 months		
	plus full-time for 3 months)		
	(2) Graduate Assistant		6,610
	7.5 man-months		
	(50% time for 9 months		
	plus full-time for 3 months)		
	(3) Research Associate		4,931
	3 man-months		
	(25% time for 12 months)		
	(4) Typist/Clerk		910
	1.2 man-months		
	(20% time for 12 months)		
		Sub	\$ 31,301
	b. Employee Benefits		5,165
	(16.5% of 1a.)		
	c. Computer Services		1,980
	d. Drilling Fluid Supplies, and Nitrogen Gas		14,520
	e. Office Supplies and Report Reproduction Costs		1,320
	f. Travel		1,320
2.	Indirect Costs		15,494
	(49.5% of 1a.)		
		TOTAL	<u>\$ 71,100</u>

TABLE 9 - RECOMMENDED USGS FUNDING SCHEDULE

<u>Date</u>	<u>Task</u>	<u>Faculty Salary</u>	<u>Staff Salary</u>	<u>Grad. Stud. Salary</u>	<u>Employee Benefits</u>	<u>Indirect Costs</u>	<u>Supplies &amp; Equipment</u>	<u>New Well Facility</u>	<u>Travel</u>	<u>Total</u>
8/23/78	1,4a,b	1,370 3,237 13,446	13,007	12,000	6,717	19,808	19,600	-	1,600	90,785
10/25/79	3,5	19,192	17,100 3,940	13,748	8,421	25,910	1,500 2,500	-	4,000	96,311
5/1/80	2a	5,708	658 970	-	1,145	3,522	1,100	15,000 41,000 29,000	550	98,653
9/1/80	2b									
	4c,d	17,040	4,458 1,644	7,768	5,100	15,300	4,840 12,100 1,210	164,853	1,210	
	6a,b	15,331	4,458 1,644	5,975	4,522	13,567	1,815 12,100 1,210	-	1,210	
	7a,b	16,628	4,458 1,644	5,975	4,736	14,209	1,210 1,210 1,210	-	1,210	361,945
9/1/81	4e	5,141	683	3,966	1,615	4,846	5,280 1,320 11,880	-	1,320	
	6c	16,959	4,931 683	3,966	4,379	13,137	1,320 11,880 1,320	-	1,320	
	7c	5,018	4,931	6,610 910	2,882	8,647	1,320 1,980 14,520		1,320	197,364
	8	18,850	4,931	6,610 910	5,165	15,494	1,320		1,320	
TOTAL		137,920	70,140	68,438	44,682	134,440	124,525	249,853	15,060	845,058